. S. CIVIL AERONAUTICS AUTHORITY

WASHINGTON, D. C.

AIR MARKING

CIVIL AERONAUTICS BULLETIN No. 12

OCTOBER 1, 1938

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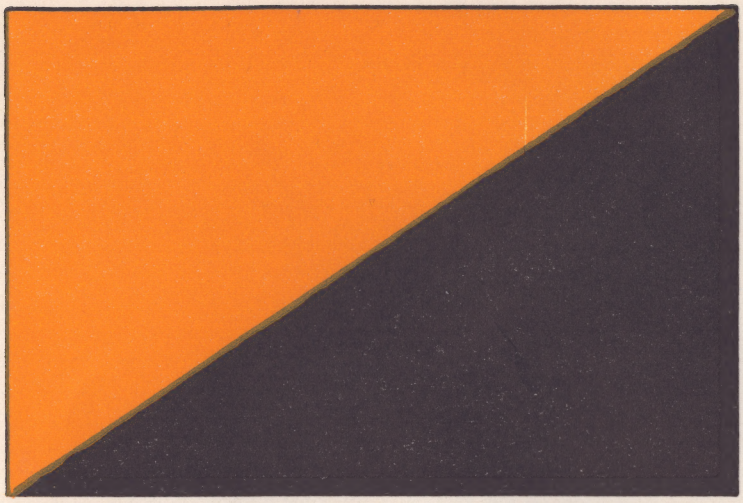
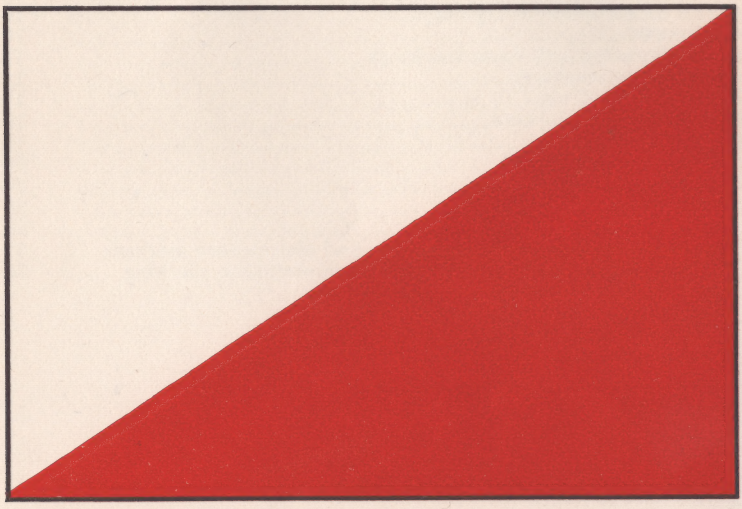
COLOR COMBINATIONS



Color combination recommended for painted roof markers, letters to be yellow outlined with black. War Department Yellow, Number 4, Federal Specification TT-P-53. Black, Federal Specification TT-P-61.



Color combination recommended for marking obstructions and painting of airport boundary markers. International Orange Federal Specification TT-P-59. White, Federal Specification TT-P-36.

AIR MARKING

The air marker is one of the simplest and least expensive aids to air navigation in common use in the United States, but it is at the same time one of the most effective and necessary, particularly so far as the private or itinerant flyer is concerned. Perhaps the chief hazard concerned in "contact flying" is the danger of becoming lost due to poor visibility or other reasons, and it is obvious that this hazard is considerably lessened, if not eliminated, if the flyer can ascertain his exact whereabouts and orient himself by merely looking down as he passes over a town or city and reading a sign giving this information. This is the function of air markers.

To serve this purpose effectively, air markers should be as simple as possible, and should be of sufficient size to be legible under good visibility conditions from a height of at least 3,000 feet.

It is also apparent that this purpose cannot be achieved if there are only a few widely scattered air markers throughout the country. Fliers may become lost in any locality under conditions of poor visibility and it is therefore desirable to have every city, town, and village air marked. The Civil Aeronautics Authority will be glad to assist regional, State, or local officials in planning air-marking programs or individual markers.

The three major subjects discussed in this bulletin are "Types of air markers," "Methods of construction," and "Air marking airports."

In constructing air markers, if suitable area is not available to accommodate the complete names in letters of ample size, it is more desirable to use an abbreviation than to reduce the size of the lettering. No abbreviations should be used, however, that are likely to be misunderstood.

Information in this bulletin is based on a study and tests made by a special committee on air marking, with modifications and additions as have been found necessary through the actual construction of thousands of air markers and their observation under varying weather and light conditions.

TYPES OF AIR MARKERS

Four general types of air markers are recommended for use as air navigational aids. They are the airport town marker, the intermediate town marker, the directional marker, and the highway route marker, which are described and used as follows:

The airport town marker is placed in a community that is served by an airport and consists of the name of the community, the abbreviated name of the State, an arrow indicating true north, and an airport pointer that indicates the direction and distance to the airport. An air-

port pointer is composed of an airport symbol (a circle), and an arrow leading from the circle and pointing to the airport. At the end of the arrow is indicated the distance to the airport in miles. In the event the community is served by more than one airport, the airport pointer should indicate the nearest airport on which it is safe to land aircraft

FIGURE 1.—Typical airport town marker includes the name of the city and abbreviated name of State, meridian marker with arrow pointed true north, and circle airport symbol with arrow and numeral indicating the direction and number of miles to the airport.

in bad weather, if only one pointer is used. In large communities where several airports exist, it is desirable to have a complete airport town marker in each of the suburban districts supplemented by several airport pointers. This will enable pilots to orient themselves easily

FIGURE 2.—Intermediate town marker. This marker includes the name of the town and State, the meridian marker, and shows direction and distance to nearby towns having airports.

from the air. It will also help pilots to locate the particular airport on which they desire to land.

The intermediate town marker is placed in a community that is not served by an airport and consists of the name of the community, the abbreviated name of the State, an arrow indicating true north, and one or more outline arrows that indicate the direction to nearby airport towns along routes generally followed in bad weather,[1] and which show inside the arrows the name of the town to which they point and outside the arrows the distance to the town in miles. In case there is

[1] Routes easily followed in bad weather include those along prominent landmarks such as highways rivers, railroads, etc.

only one general direction in which there are airport towns sufficiently close to be indicated by outline arrows, the nearest airport town only should be shown. It is desirable in indicating more than one airport town by outline arrow to select towns located in directions having a divergence of at least 90°.

The directional marker is placed where there is no community large enough to be shown on air-navigation maps, and yet an air marker is

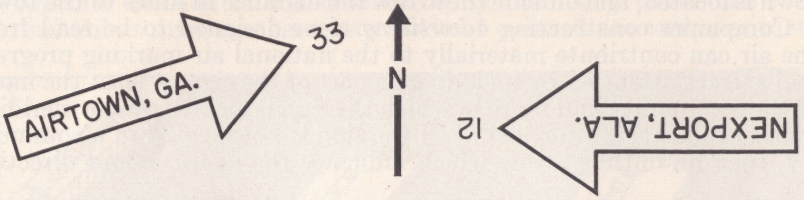


FIGURE 3.—The directional marker. This type of marker is used in a community the name of which is not shown on air-navigation maps. The outline arrow and the accompanying numerals indicate the direction and distance to nearby towns having airports.

needed in order to provide a good general coverage. It consists of an arrow indicating true north and one or more outline arrows as described under the "intermediate town marker." These arrows show inside the outline in addition to the name of the city or town, the abbreviated name of the State in which they are located.

The highway route marker is placed on or along a highway at appropriate intervals (every 15 miles preferably) and consists of the official

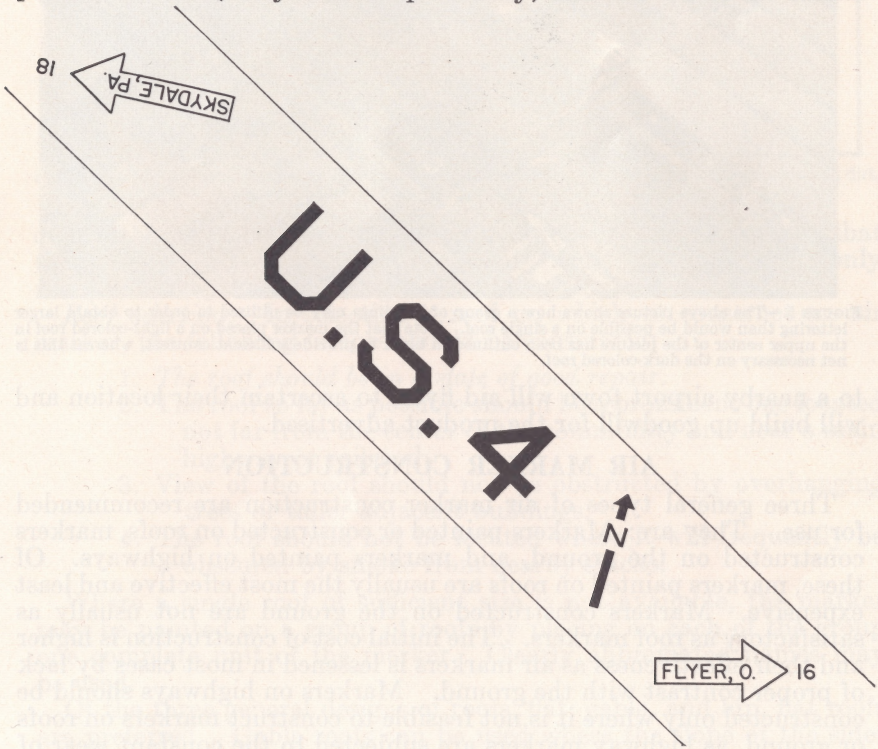


FIGURE 4.—Typical highway marker lay-out. The air marker on a highway is painted on the pavement or inlaid at the time of construction. The above lay-out includes the number of the highway, the meridian marker indicating true north and two outlined arrows indicating the direction and distance to nearby towns having airports.

number of the highway, preceded by the letters U. S. in the case of a Federal highway, or the abbreviated name of the State in the case of a State highway. However, a marker giving this information only may be of little value, and it is, therefore, recommended that all such markers include an outline arrow which indicates the direction to the nearest airport town, and which shows inside the arrow the name of the town and the abbreviation of the name of the State in which the town is located, and outside the arrow the distance in miles to the town.

Companies constructing *advertising signs* designed to be read from the air can contribute materially to the national air-marking program and attract attention by including as part of the sign at least the name of the community and State in which the sign is located, and a meridian marker indicating true north. If the sign is not located in a community, then an outline arrow which indicates the distance and direction

FIGURE 5.—The above picture shows how a group of buildings may be utilized in order to obtain larger lettering than would be possible on a single roof. Note that the marker placed on a light-colored roof in the upper center of the picture has been outlined in black to provide sufficient contrast, whereas this is not necessary on the dark-colored roof.

to a nearby airport town will aid flyers to ascertain their location and will build up goodwill for the product advertised.

AIR MARKER CONSTRUCTION

Three general types of air marker construction are recommended for use. They are: Markers painted or constructed on roofs, markers constructed on the ground, and markers painted on highways. Of these, markers painted on roofs are usually the most effective and least expensive. Markers constructed on the ground are not usually as satisfactory as roof markers. The initial cost of construction is higher and their effectiveness as air markers is lessened in most cases by lack of proper contrast with the ground. Markers on highways should be constructed only where it is not feasible to construct markers on roofs or ground, as highway markers are subjected to the constant wear of vehicular traffic and retain their effectiveness for only a short period of time.

AIR MARKERS CONSTRUCTED AND PAINTED ON ROOFS

One of the most effective methods of constructing air markers is by painting them on roofs. Large flat, or nearly flat, roofs are conspicuous landmarks to flyers and are naturally adapted to air marking because they furnish an even background and the air marker is less likely to be obscured by dirt, dust, and snow. Such markers when properly painted may remain clear and legible for 2 years or more.

Another method of construction is by mounting above the roofs, on suitable supports, characters made of painted noncorrosive metal,

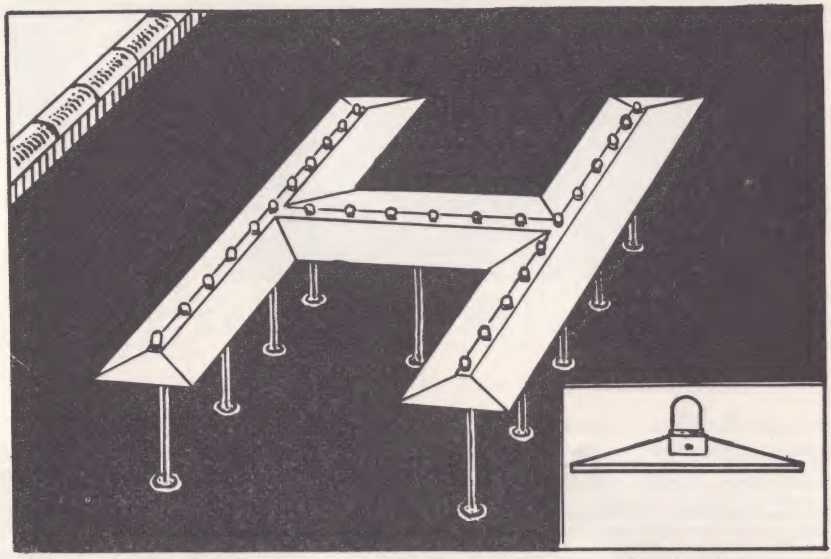


FIGURE 6.—Method of raising letters of air marker above roof to prevent sign being obscured by snow, dirt, etc. The illumination of the letter by exposed incandescent lamp is also shown.

or of other suitable material. This method has the advantage that the marker is less frequently obscured by snow. It is not commonly used, however, due to the high cost of construction.

Roof selection.—In selecting a roof on which to construct an air marker, the following factors should be considered:

1. *The roof should be in a state of good repair.*
2. The roof so far as possible should be a prominent one located not far from the center of the community and near a main highway or railroad.
3. View of the roof should not be obstructed by overhanging trees or taller adjacent buildings.
4. The roof should not be located where it will frequently be obscured by smoke from nearby stacks.

Where a single roof of sufficient size is not available, the marker may be painted on a group of roofs by placing on each of the group one complete unit of the marker. Clearly abbreviated names may be used.

Of the three general designs of roofs, flat, gable, and hip, flat roofs are preferred. Gable roofs can be used where the slope of the sides is not too great, but when used it is preferable that each side should

have the complete marker. Hip roofs should be avoided, if possible, as some portions are too nearly vertical to be of use.

Roof surfaces may be divided into two general groups: Those that may be painted without damage to the roofing material, and which include metal, concrete, tile, slate, wood shingle, and wood composition surfaces; and those that may be damaged when painted, which include bituminous composition and bituminous covered surfaces (with or without a gravel top).

Of the roof surfaces that may be safely painted, metal is perhaps the best, in that less paint is required, and a longer life for the marker may be anticipated. Concrete, tile, slate, and wood composition

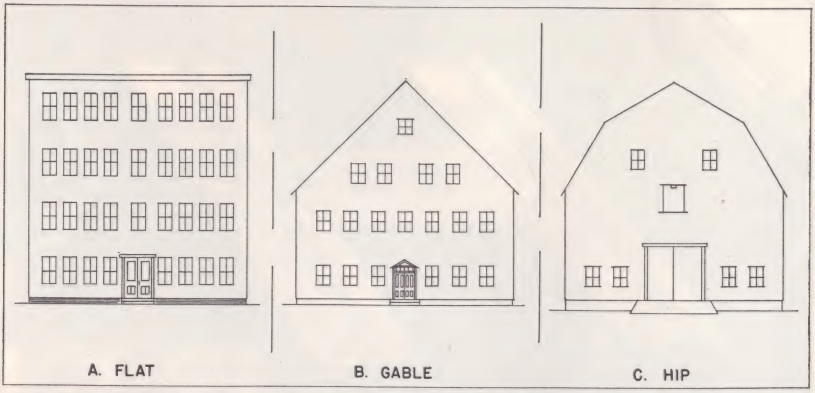


FIGURE 7.—Types of roof construction: *A*, A large flat roof is preferable for the construction of an air marker since the sign can be seen readily from all angles of approach; *B*, a gable roof is less desirable than a flat roof for the construction of an air marker since if the pitch of the roof is steep, and the sign is placed on one side of the roof only, the air marker may not be visible from all angles and elevations of approach. To meet this difficulty, the name of the city and abbreviation for name of State is frequently repeated on the opposite side of the roof; *C*, a hip roof is the least desirable type roof for air-marker construction. It has the same disadvantage that the gable-type roof has in that the sign, if painted on one side of the roof only, may not be visible from all angles and elevations of approach. A hip-type roof should not be selected for the construction of an air marker if any roofs having sufficient area of the flat or gable type are available.

surfaces may all be satisfactorily painted at a low average cost. Wood-shingle roofs are less desirable in that they require more paint.

Markers should not be painted on bituminous composition or bituminous coated roofs unless these roofs are relatively new and in a state of good repair as otherwise it is hard to prevent the paint from "bleeding through."

Color combinations.—The distance at which air markers are legible depends largely upon the degree of contrast between the characters and the background. Best results are obtained by using the lighter color for the characters and the darker for the background. A combination of chrome yellow (see yellow No. 4 of color card supplement to U. S. Army Quartermaster Specification No. 3–1, or Paint Specification Nos. TT–P–53 and TT–P–61) with a dead black background has been found to be most effective. In this connection it should be noted that the color, international orange, often used in the past, is no longer recommended by the Civil Aeronautics Authority, since experience has shown that this color is less effective than chrome yellow for air markers. Chrome-yellow markers constructed on light-colored roofs such as slate, concrete, tile, or unpainted galvanized iron, should be outlined with dead black, and the interior background as well as the outside border of outline arrows should also be black.

FIGURE 8.—Air marker painted on light-colored roof. Note selection of prominent roof adjacent to highway and railroad. Also note old air marker on top section of roof and the contrast of its effectiveness with the new standard marker. To complete the air marker the abbreviation for the name of the State should be added.

CHROME YELLOW, READY-MIXED PAINT FOR AIR MARKERS

1. *General.*—This specification covers the general requirements for yellow paint for use on steel, concrete, and wood surfaces, such as galvanized-steel towers, service sheds, tank houses, concrete directional arrows, galvanized-iron roof surfaces, slate and tile roof surfaces, etc. The color shall be the same as yellow No. 4, on color card, supplement No. 3–1, United States Army Quartermaster Specifications. (See Federal Specification TT–P–53.)

2. *Composition.*

	Percent by weight	
	Maximum	*Minimum*
Pigment	66	62
Liquid	38	34
Water	0.7	--
Coarse particles and "skins" (325 screen)	2	--

3. *Pigment.*

	Percent
Chemically pure medium chrome yellow	60
Lead-free zinc oxide	20
Extending pigment	--
Barytes, siliceous matter, or mixture thereof	20

4. *Liquid.*

	Percent
Raw linseed oil	80
Spar varnish—Federal specification TTV121a	10
Drier and thinner	10

5. *Weight per gallon.*—Not less than 15 pounds.

BLACK, READY-MIXED PAINT FOR AIR MARKERS

1. *General.*—This specification covers the general requirements for black paint for use on steel, concrete, and wood surfaces, such as galvanized-steel towers, service sheds, tankhouses, concrete direc-

tional arrows, galvanized-iron roof surfaces, slate and tile roof surfaces, etc. (See Federal Specification TT–P–61.)

2. *Composition.*	*Percent by weight* Maximum	Minimum
Pigment	32	28
Liquid	72	68
Water	0. 5	--
Coarse particles and "skins" (325 screen)	1. 5	--

3. *Pigment.*	*Percent by weight* Maximum	Minimum
Carbon	--	20
Lead oxide	--	5
Carbon, lead oxide, insoluble mineral material, and loss on ignition	--	90

4. *Liquid.*	*Percent by weight* Maximum	Minimum
Raw linseed oil	--	80
Thinner and drier mixture	20	--

5. *Weight per gallon.*—Not less than 9 pounds.

Letters and characters.—The legibility of air-marking signs depends, in addition to the color combination used, upon the size, shape, and spacing of the letters and characters. For markers constructed on roofs, a letter size of 10 to 20 feet is recommended. Clear abbreviations not likely to be misunderstood may be used in order to permit the use of greater letter size than would be possible otherwise.

FIGURE 9.—Photograph of an air marker painted on a light-colored roof with black outline. Air marker includes name of community, meridian marker, and three directional pointers giving direction and mileage to nearby airport towns. It is recommended that the abbreviation of the name of the State be added.

The letters and numerals recommended are of two styles, gothic capitals and plain block capitals, of which block capitals are preferred since they are easier to lay out. Assuming one-seventh of the letter

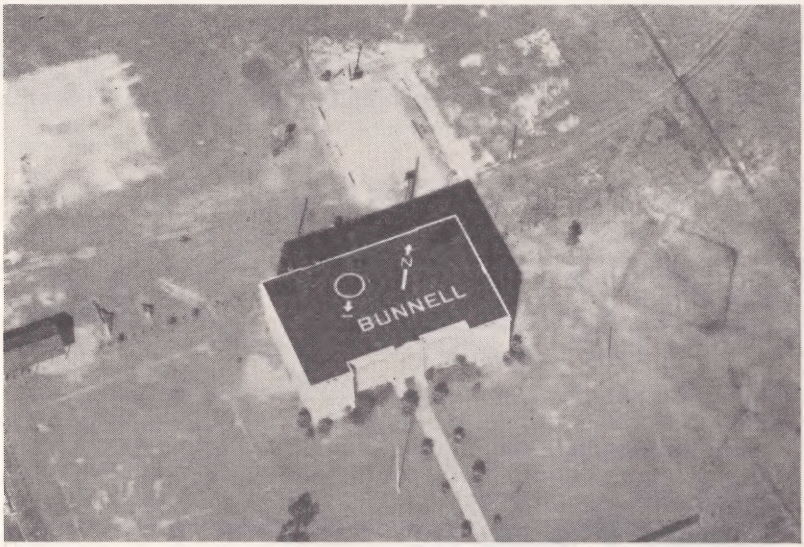


FIGURE 10.—Air marker showing chrome-yellow lettering where the background is entirely black.

height as a unit of measurement, the stroke of the letters should be one unit and they should be spaced not less than one unit apart. Letters enclosed by outline arrows should have a margin between the stroke of the arrows and the letters of at least one and one-half units.

FIGURE 11.—Air marker.

The stroke of outline arrows should be the same as the stroke of the letters they enclose. The length of outline arrows should be determined by the name or names they enclose.

Where it is necessary to paint letters or characters on light-colored roofs (see color combinations) a black border should be painted around

the letters or characters one-half of one unit in width. However, where funds are available for the additional paint, a solid black background should be used as it makes the sign more effective.

Construction of painted roof air markers.—After the selection of the roof on which it is planned to construct an air marker, the next problem is the laying out of the letters, numerals, and characters. In doing this it is of the utmost importance that the directional pointers, the airport pointers, and the north arrows indicate exact directions and distances.

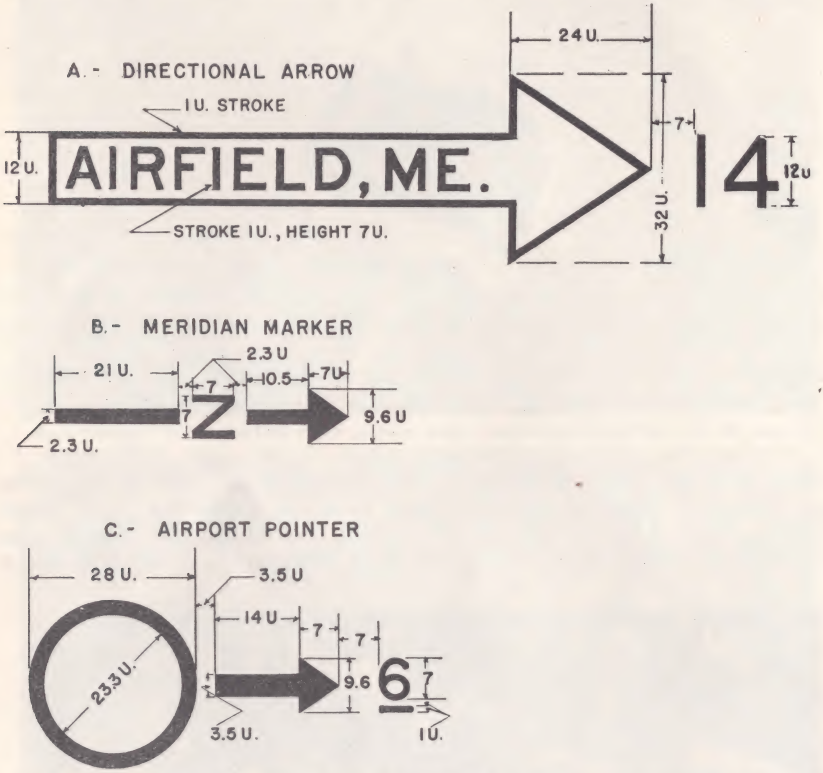


FIGURE 12.—Proportions of characters used in air markers: *A*, The directional arrow; *B*, the meridian marker; *C*, the airport pointer. In each of the above characters, the unit of measurement is one-seventh the height of letters or numerals used in connection with the characters.

A map of known accuracy and a good compass should be used, taking into consideration in the use of the compass the magnetic declination of the section of the country in which the marker is to be constructed. In using a magnetic compass, care should be taken to correct for the magnetic effects of metal roofs, power lines, and other nearby metal objects. Letters and figures should be uniform to the scale recommended and their arrangement should be simple.

When the lay-out is complete the marker is ready to be painted. The surface on which the paint is to be applied should be thoroughly cleaned and any spots of grease or oil should be removed.

The painting of *new* galvanized iron is uncertain in its results. Some reports indicate that by washing the galvanized metal with vinegar and allowing it to dry thoroughly before painting better results are obtained. Another recommendation is that the surface of the

metal be scrubbed well with burlap wet with benzine. The best method, however, seems to be to leave the galvanized metal exposed to the weather for several months before attempting to paint it.

The following method of treatment of galvanized-iron surfaces before painting is used by the United States Bureau of Lighthouses:

> In 1 gallon of soft water dissolve 2 ounces each of copper chloride, copper nitrate, and sal ammoniac, then add 2 ounces of commercial muriatic acid. This should be done in an earthen or glass vessel, never in a tin or other metal receptacle. Apply the solution with a wide flat brush to the area of the galvanized iron which is to be painted. It will assume a dark, almost black color, which on drying becomes a grayish film.

All painting should be done in a careful and workmanlike manner. Each coat of paint should be allowed to dry thoroughly before the succeeding coat is applied. Paint should be applied only when the temperature is above 40° F., and it should not be applied upon damp or frosty surfaces. In the western sections of the country consideration should be given to dust storms and an attempt should be made to paint the sign at such a time as will permit the paint to set before such a storm occurs.

In case the air marker is to be painted on a bituminous composition roof only relatively new roofs in good repair should be used. The area covered by the sign should be thoroughly cleaned and painted with a seal coat of aluminum paint. The aluminum paint serves a twofold purpose: First, it prevents the bituminous material from "bleeding through" and destroying the effectiveness of the air marker; second, the aluminum forms a protective film between the paint and the roofing surface and minimizes the possibility of damage to the roofing material from ingredients of the paint. The aluminum paint may be prepared by mixing 2 pounds of powdered aluminum per gallon of good grade spar varnish. (See Federal Specification TT–V–81.)

Illumination of roof air markers.[1]—In order that air markers may serve their full purpose, it is desirable that they be illuminated at night. However, because of the high construction, operation, and maintenance costs of such illuminated signs, it may not be practicable to install them in many localities. The problems involved in illuminating such markings are fundamentally the same as those encountered in illuminating large advertising signs except the air markers are horizontal instead of vertical.

There are two general systems of illumination that are applicable to air markers, as follows:

1. By direct light, in which the markers are outlined by exposed incandescent lamps or gaseous-discharge tubes, preferably placed along the center line of the strokes of the letters and characters. (Markers may be made up of suitable colored reflecting surfaces giving good day visibility and which are illuminated for night operation by the exposed lamps, thus augmenting the effect of the lamps.)
2. By reflected light, in which case either floodlight projectors with spread lenses (and when necessary, with suitable shields or visors to cut off stray upward light) or industrial reflectors are so arranged as to give a uniform distribution of light of proper intensity over the entire surface of the markers.

Illumination by direct light is more effective than floodlighting because of brilliance, and hence greater attracting power. Markers

[1] See also Civil Aeronautics Bulletin No. 10, Airport Lighting, published by the Civil Aeronautics Authority.

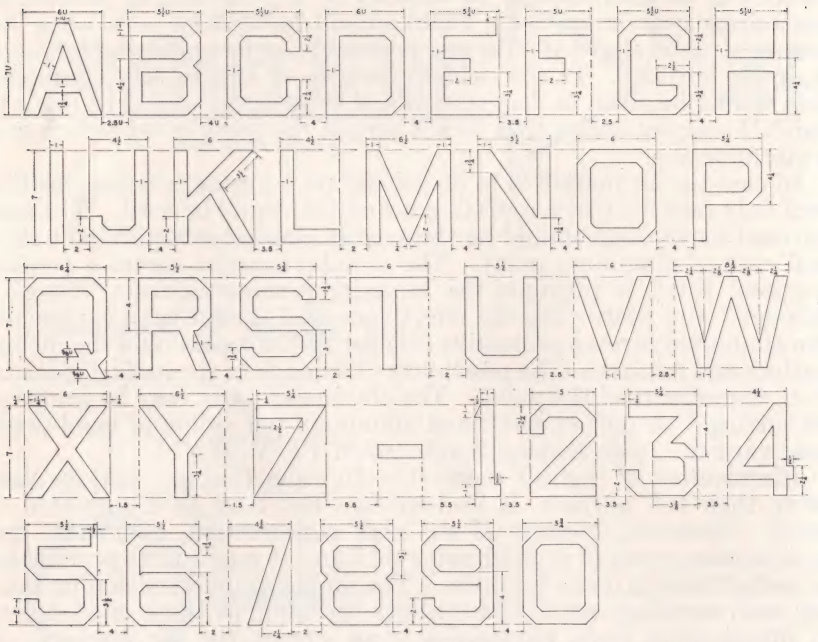


FIGURE 13.—Plain block letters and numerals. Assuming the letter size to be seven units, the proportion of the letters and numerals should be as illustrated.

illuminated in this manner are effective at night even though the color of the characters is obscured by dirt or snow. The conduit and fittings for either exposed incandescent lamps or gaseous-discharge tubes may be fastened flat on the roof with metal conduit straps or strapped to light stringers superimposed on the markers. The conduit and fittings and the stringers when used should be painted the same color as the marker.

For outlining with incandescent lamps, 15-watt frosted sign lamps should be used, spaced 12 inches apart, for small letters; 25-watt frosted sign lamps, spaced 18 inches apart, for larger letters.

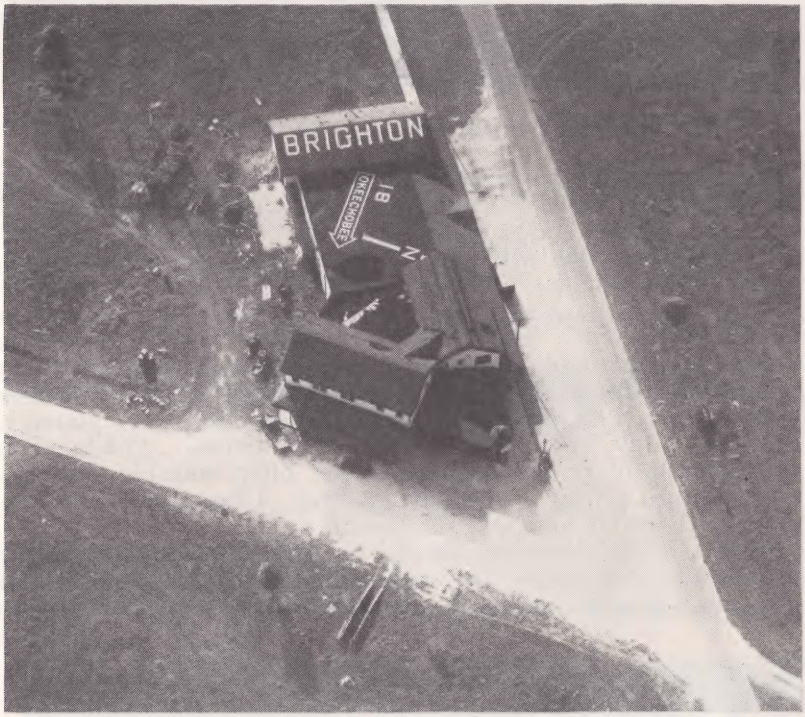


FIGURE 14.—This photograph shows how a group of buildings may be used to accommodate all units of an air marking sign. Abbreviation for name of State should be added.

The reflected-light system of illumination is the simplest to install and gives good results if the markers are kept clean and free from snow, but it does not have the attracting power of the other systems. It is recommended that the average intensity of illumination on the surface of the markers for the reflected-light systems be not less than 10 foot-candles and preferably not less than 15 foot-candles.

In general, as the amount of illumination in the vicinity of the air marker is increased, it may be necessary to increase the brilliance of the marker, and/or use color effect, and/or flash the marker lights in order that it may have the necessary power of attraction.

In planning the illumination of markers, care should be exercised to provide well-divided circuits with the least possible voltage drop, as a slight drop in voltage will materially reduce the output of the lamps. It is advisable to use wire of ample size to carry at least

twice the proposed load, as it may later be found necessary to increase the wattage of the lamps. It is recommended that the entire electrical installation be made in accordance with the rules of the National Safety Code published by the National Bureau of Standards of the United States Department of Commerce.

Maintenance of roof air markers.—It is necessary that air markers be properly maintained if they are to fulfill their purpose of conveying information to air travelers. The markers should be swept or washed from time to time as may be necessary to keep them free from an accumulation of soot or dirt in order to preserve the contrast between the markers and their background and thus insure maximum legibility. Arrangements should be made for such periodic repainting as local conditions may dictate; also for the proper maintenance of lighting equipment in case the markers are illuminated for night flying.

AIR MARKERS CONSTRUCTED ON THE GROUND

Two commonly recommended methods of constructing air markers on the ground are: First, by construction with crushed stone or gravel, bound with a cement and sand mixture or some other suitable binder; second, by construction with crushed stone, gravel, or other suitable aggregate without binder. The first method, though having a higher initial construction cost than the second, has very low maintenance cost and is permanent. The second method has a higher maintenance cost than the first, and the stone in the marker may be gradually displaced or scattered, thus eventually rendering the marker useless.

Location.—Markers constructed on the ground should be placed in open spaces away from trees or other obstructions. Public parks or the grounds of public institutions are often suitable locations. Privately owned property may also be used. Cleared hills or mountains make desirable locations for ground markers.

Characters.—The characters should be of the same proportions as those recommended under "air markers constructed on roofs," with the exception that in the case of ground markers the minimum letter

FIGURE 15.—Air marker constructed on the ground. Note use of area in front of a public building and excellent maintenance which results. This marker was constructed of fluorspar, which is available at low cost in some sections of the country. The fluorspar has the property of turning white as a result of weathering.

FIGURE 16.—Ground air marker in course of construction. Note piles of coarse and fine aggregate.

height should be 15 feet (25 feet or larger is preferable). Plain block capital letters and numerals are more easily laid out and constructed on the ground than are gothic capitals.

Color combinations.—As stated before, in many cases the ground affords a poor background for air markers. In such cases the characters should be constructed on an artificial background of sod, cinders, or some dark material which should extend at least one unit [1] beyond the top, bottom, and both ends of the marker. The letters and characters should be white.

FIGURE 17.—Cement-bound stone marker.

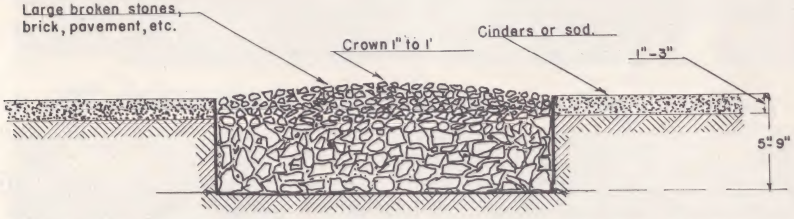


FIGURE 18.—Cross section of loose stone ground marker. After excavating for the letters the ground in and around the excavation should be treated with some vegetation-killing compound. Then the aggregate should be placed in the excavation and thoroughly compacted, the larger aggregate being at the bottom and the smaller at the top. Upon completion the face of the letters should be painted with white portland cement and skimmed milk.

Construction of ground markers.—In laying out markers to be constructed on the ground the same care should be exercised as is described under "construction of painted roof markers." Letters, numerals, and characters should be uniform and simple in their arrangement.

[1] See "letters and characters" under "air markers constructed and painted on roofs."

The ground should first be cleared of all vegetation and then the characters outlined on the ground and excavated to the width and depth required by the method used.

To construct a marker of stone bound with a mixture of cement and sand,[1] the characters should be excavated to a depth of 5 inches where a background of cinders or sod is to be used. (The edges of markers on airports should be beveled to prevent damage by airplane tail skids.) Broken stone, bricks, pavement, or aggregate native to the locality should be placed in the excavation and the cement mixture poured over it and packed in. The top and sides should be shaped as illustrated. When cinders are used as a background they should be thoroughly compacted. If desired, a binder of asphaltic oil may be applied. The top of the marker should then be painted with a mixture of white portland cement and skimmed milk or water.[2]

To construct a marker of loose aggregate the characters should be excavated to a depth of from 5 to 9 inches and the entire area of the trench then treated with some vegetation-killing compound.

A mixture of crude oil and salt is nonpoisonous and will discourage the growth of vegetation for a short period of time. A more effective compound is a solution of sodium arsenite, but since this material is poisonous it should not be used on playgrounds, or areas where animals graze. The trenched characters should then be filled and packed tightly with the aggregate and the face or top of the marker leveled by covering with fine aggregate and painted with the mixture of white portland cement and skimmed milk. Cinders, sod, or some other dark material suitable for the background should be placed around the characters.

Illumination of ground markers.—Where it is desired to illuminate an air marker constructed on the ground, this may be done by reflected light as described under "illumination of roof air markers."

Maintenance.—Ground markers constructed of crushed stone, bound together with a cement grout, require only an occasional repainting with white portland cement and skimmed milk mixture. Other ground markers constructed of loose aggregate should be repainted at least once a year with the white portland cement and skimmed milk mixture, at which time all aggregate which has been displaced should be restored.

AIR MARKERS CONSTRUCTED ON HIGHWAYS

In painting air markers on highways, care should be taken that the markers are located along open stretches of road away from overhanging trees, tall buildings, and other obstructions. The style, proportion, and size of the characters should be the same as described under "air markers constructed on roofs." Their color should be chrome yellow, outlined with dead black where necessary.

Markers should be laid out on highways in a similar manner to the lay-out of markers on roofs, and then painted with at least two coats of a good grade of traffic paint, allowing each coat to dry thoroughly before the next coat is applied or before the highway is used.

[1] Mixture made by mixing 1 part of cement with 2 parts of sand, and enough water to form a dry, mealy mortar.

[2] Mixture made by mixing 5 pounds of white portland cement with 1 gallon of skimmed milk or water.

In order that highway markers be continuously effective they must be repainted whenever necessary. In this respect it is suggested that

FIGURE 19.—Air marker constructed of concrete adjoining a railroad station. Marker shows name of community and meridian pointer. Abbreviated name of the State should be included. Note excellent maintenance of marker and sod background.

they be inspected at regular intervals, preferably at least twice a year, for signs of wear and other defects.

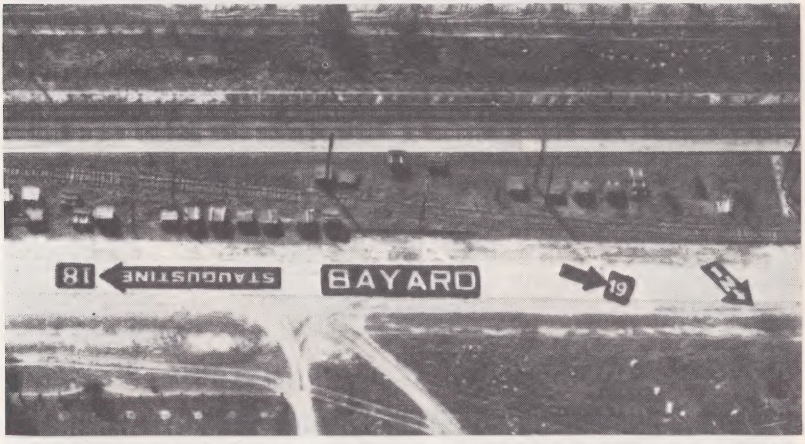


FIGURE 20.—Air marker painted on highway at Bayard, Fla. Signs painted on heavily traveled highways require repainting at least twice a year. Note the two directional arrows giving the direction and mileage to St. Augustine, and Jacksonville, Fla., and the meridian marker indicating true north. The abbreviation for the name of the State should be added to complete the sign.

AIR MARKING AIRPORTS

Unless properly marked an airport loses a considerable part of its value to the flying public. Such markings should be readily discernible from the air at a minimum height of 3,000 feet and should include at least a standard marking circle (in case runways have not been

installed), landing-area boundary markings, the name of the airport, city, and State and a meridian marker. In addition, it is extremely important that all obstructions on or in the vicinity of the airport

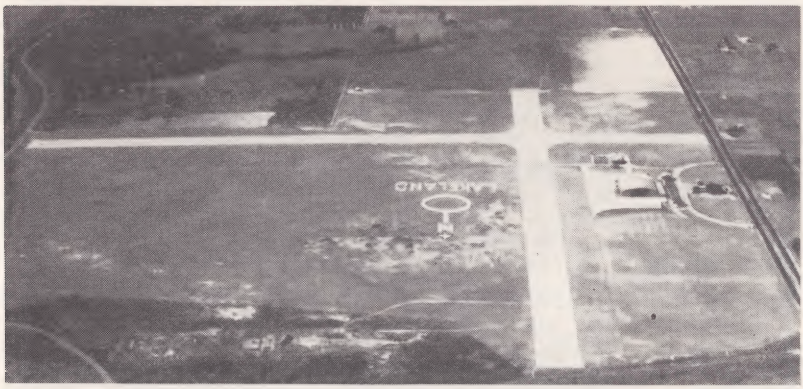


FIGURE 21.—Air marker constructed of white lime rock and imbedded in the landing area.

be marked in accordance with the recommendations of the Civil Aeronautics Authority.

AIRPORT IDENTIFICATION AND ROUTE MARKINGS

Identification markings.—Identification markings at airports should include at least the name of the airport, the name of the community

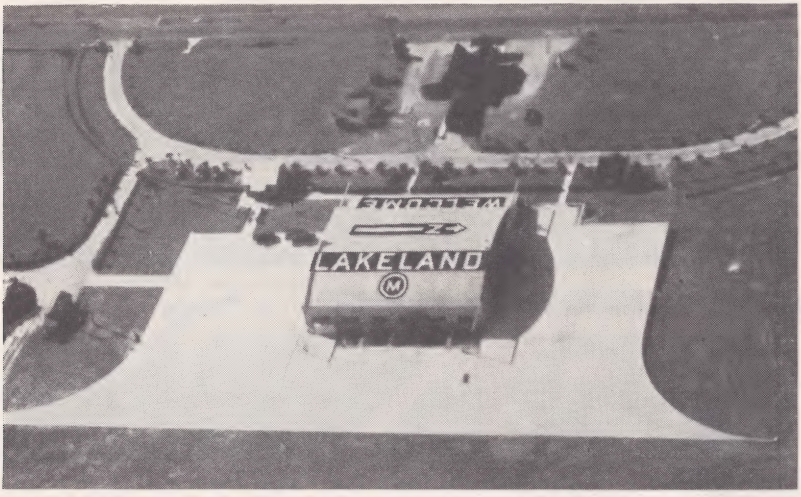


FIGURE 22.—Air marker on a hangar roof. In the case of a municipal airport the letter **M**, enclosed in a circle to prevent confusion in reading the sign, may be used instead of repeating the name of the city. The abbreviation for the name of the State should be added to complete the sign.

served by the airport, the abbreviation for the State, and an arrow indicating true north. If the airport is a municipal airport, the letter M, surrounded by a circle, may be used in lieu of repeating the name of the city. In case it is used, the letter M should be placed in

front of, above, or below the name of the city and State as may be most convenient in the lay-out of the sign.

As has been mentioned in the discussion of air marking, if sufficient area is not available to accommodate the complete names of the city and State in letters of ample size it is more desirable to use a clear abbreviation than to reduce the size of the letter. No abbreviations should be used, however, that are likely to be misunderstood. The painting or construction of identification markers at airports follows the same general methods which have been discussed under "air marking." Such markers may be painted or constructed on the roofs of buildings located on the airport or immediately adjacent, painted on highways along the airport boundaries, or constructed on the ground either within or without the limits of the landing area.

Methods of painting or constructing these markers have been covered in the discussion of air-marking signs and will not be repeated here. However, in the case of identification markers constructed on a portion of the landing area of concrete or similar material it is necessary to provide transition strips for the letters along the lines discussed for the circle marker. The size of letters, color combinations, location, methods of construction, etc., recommended for air-marker signs apply in the case of airport identification markers, and reference may be made to these subjects in earlier sections of this bulletin.

Directional markings.—Where space is available and funds will permit, it is desirable to construct one or more directional arrows as an aid to the itinerant pilot. These directional markers consist of outline arrows which indicate the direction and distance to nearby airport towns or, if the airport is located on a recognized airway, the direction and distance to other airport towns on that airway.

HIGHWAY DIRECTIONAL MARKERS

In order that ground traffic may be easily directed, all street intersections and roads leading to airports should be conspicuously marked with standardized signs. These signs should be distinctive in appearance as well as color, constructed in the form of cut-out arrows approximately 36 inches long by 6 inches wide, with the word "AIRPORT" painted thereon, and mounted near the top of a suitable post. Painting posts with alternating bands of contrasting colors will increase the effectiveness of these signs. (See figure No. 3.) Metal or wood construction may be utilized. Where funds are available, larger and more elaborate signboards may be used at the entrance or along the border of the airport. (See figure No. 4.)

AIRPORT CIRCLE MARKERS

Where airports have one or more paved runways, as most major airports have at the present time, the construction of a standard circle marker to assist in identifying the landing area appears to be unnecessary. However, for those airports which have a turf surface without paved runways a standard 100-foot circle marker with at least a 4-foot band constructed at or near the center of the landing area assists a pilot materially in quickly distinguishing the landing area from the adjoining open fields. In all such cases where there is a turf surface without runways a standard circle marker should be installed.

A permanent installation is desirable, and this may be obtained by trenching to a depth of 6 inches or more and filling the trench with crushed stone, gravel, or other light-colored granular material with a suitable binder. If turf is present some method should be used to kill the grass roots or other vegetation in the bottom or the sides of the

FIGURE 23.—Highway directional marker. A signpost pointing to airport.

trench before making the installation, otherwise the grass may grow through the loose material.

The circle marker may also be made of concrete, or of construction similar to the high types of road surface. This type of construction is preferable to that described above, as granular material without sufficient binder is easily displaced by the wheels and tail skids of planes, and the circle soon looses its sharp outline. If a high type of

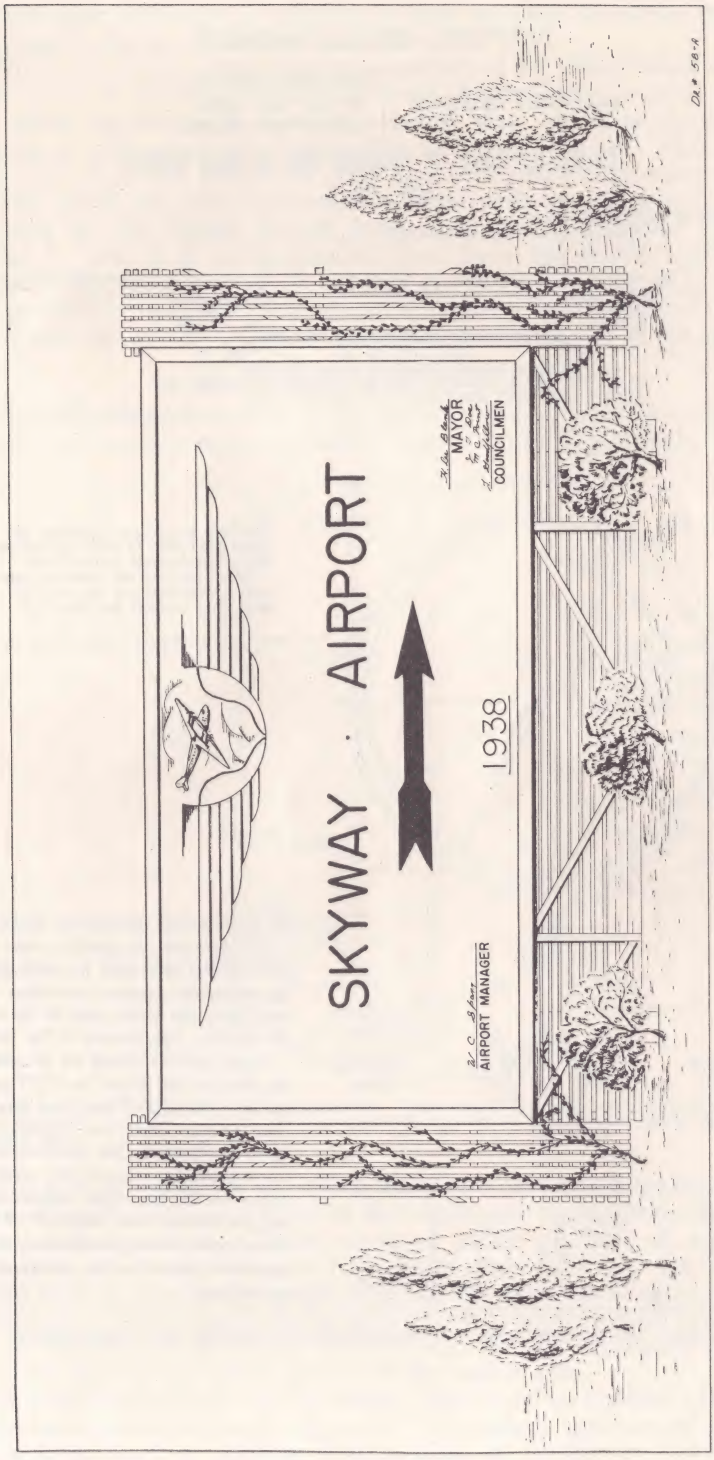


FIGURE 24.—Signboard type of directional marker.

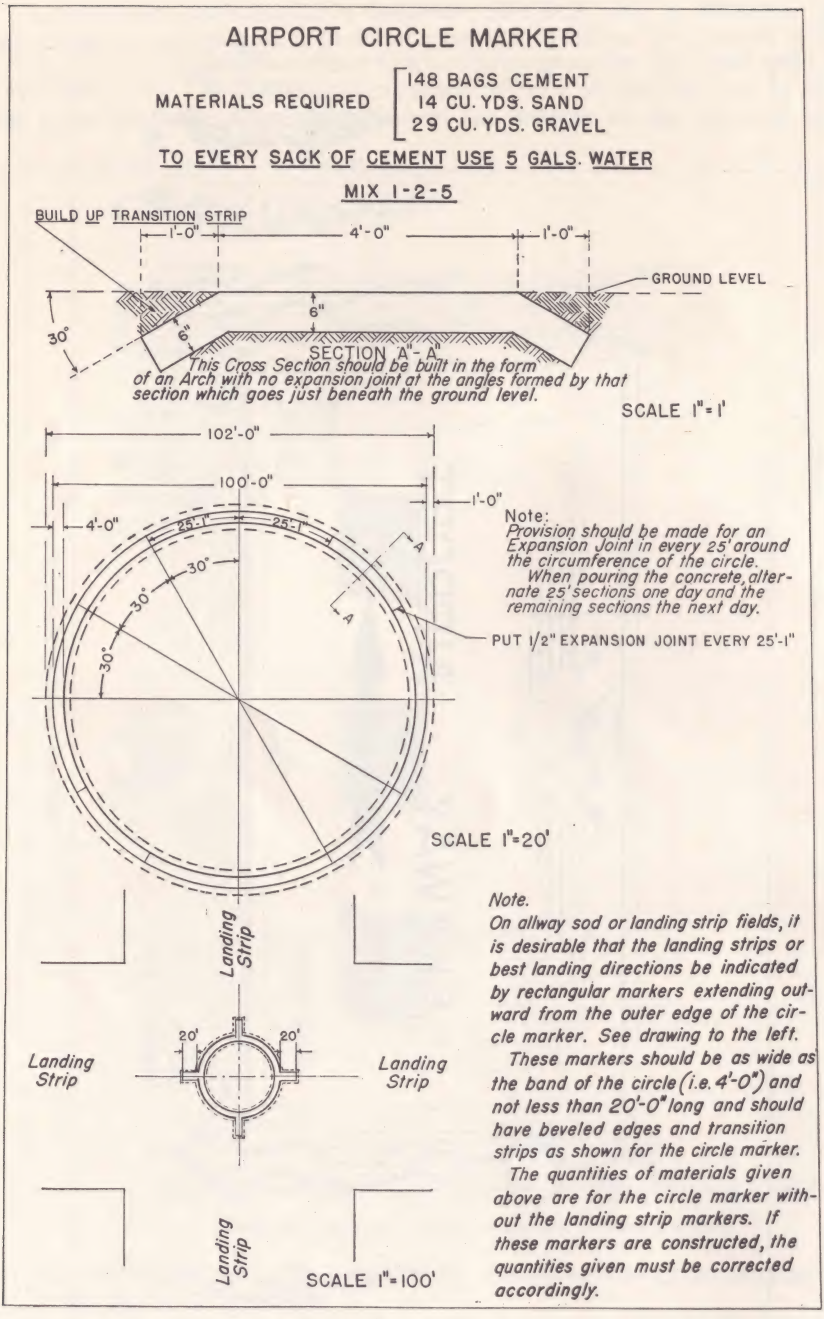

AIRPORT CIRCLE MARKER
MATERIALS REQUIRED
148 BAGS CEMENT
14 CU. YDS. SAND
29 CU. YDS. GRAVEL
TO EVERY SACK OF CEMENT USE 5 GALS. WATER
MIX 1-2-5
BUILD UP TRANSITION STRIP
1'-0"
4'-0"
1'-0"
GROUND LEVEL
6"
6"
30°
SECTION A"-A"
This Cross Section should be built in the form of an Arch with no expansion joint at the angles formed by that section which goes just beneath the ground level.
SCALE 1"=1'
102'-0"
100'-0"
1'-0"
4'-0"
25'-1"
25'-1"
30°
30°
30°
A
A
Note:
Provision should be made for an Expansion Joint in every 25' around the circumference of the circle.
When pouring the concrete, alternate 25' sections one day and the remaining sections the next day.
PUT 1/2" EXPANSION JOINT EVERY 25'-1"
SCALE 1"=20'
Landing Strip
Landing Strip
Landing Strip
20'
20'
Landing Strip
SCALE 1"=100'
Note.
On allway sod or landing strip fields, it is desirable that the landing strips or best landing directions be indicated by rectangular markers extending outward from the outer edge of the circle marker. See drawing to the left.
These markers should be as wide as the band of the circle (i.e. 4'-0") and not less than 20'-0" long and should have beveled edges and transition strips as shown for the circle marker.
The quantities of materials given above are for the circle marker without the landing strip markers. If these markers are constructed, the quantities given must be corrected accordingly.

FIGURE 25.—Airport circle marker. Method of constructing concrete circle marker is shown.

construction is used it is important that suitable transition strips be provided both inside and outside the circle.

These transition strips may be constructed by filling trenches 1 foot wide and 4 to 6 inches deep around both the inside and outside edges of the circle marker with cinders, crushed slag, or other dark-colored aggregate with a suitable bituminous or cement binder. This method of constructing the transition strip also provides a dark-colored background which will give maximum contrast with the white color recommended for the circle. If any form of concrete or similar type surfacing is used it is recommended that both the inside and outside edges of the circle marker be beveled as shown in figure 25 to prevent the possibility of an airplane tire striking the sharp edge and resulting in a blow-out, or a tail-skid shoe hanging on the corner of the concrete.

AIRPORT BOUNDARY MARKERS

The entire usable portion of the landing area of an airport should be clearly indicated in some manner. A good method, particularly where

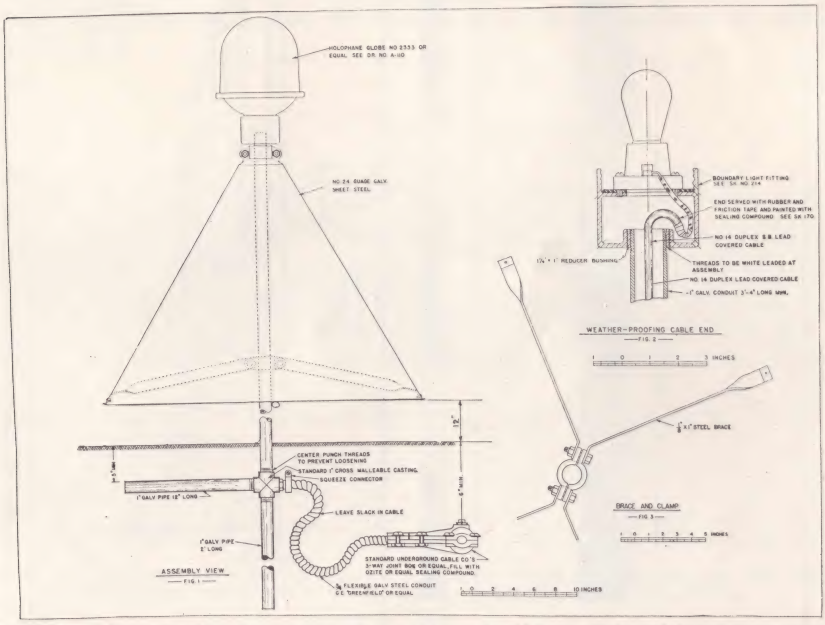

HOLOPHANE GLOBE NO 2333 OR EQUAL. SEE DR. NO. A-10
NO 24 GUAGE GALV. SHEET STEEL
CENTER PUNCH THREADS TO PREVENT LOOSENING
STANDARD 1" CROSS MALLEABLE CASTING
SQUEEZE CONNECTOR
1" GALV PIPE 12" LONG
LEAVE SLACK IN CABLE
1" GALV PIPE 5' LONG
STANDARD UNDERGROUND CABLE CO'S 3-WAY JOINT BOX OR EQUAL FILL WITH OZITE OR EQUAL SEALING COMPOUND
FLEXIBLE GALV STEEL CONDUIT O.K. "GREENFIELD" OR EQUAL
ASSEMBLY VIEW
FIG. 1
BOUNDARY LIGHT FITTING SEE SK. NO 214
END SERVED WITH RUBBER AND FRICTION TAPE AND PAINTED WITH SEALING COMPOUND SEE SK 170
NO 14 DUPLEX S.B. LEAD COVERED CABLE
1" X 1" REDUCER BUSHING
THREADS TO BE WHITE LEADED AT ASSEMBLY
NO 14 DUPLEX LEAD COVERED CABLE
1" GALV. CONDUIT 3'-6" LONG MIN.
WEATHER-PROOFING CABLE END
FIG. 2
INCHES
1/4" X 1" STEEL BRACE
BRACE AND CLAMP
FIG. 3
INCHES
10 INCHES

FIGURE 26.—Cone type airport boundary markers. Cones should be painted solid international orange for boundary markers, and with 45° wide vertical segments of international orange and white for range cones.

the airport is lighted, is to outline the area which is safe for landing and take-off with boundary cones of the color and construction in accordance with figure 26. These cones or other markers of equivalent effectiveness should be placed not more than 300 feet apart. On a small field it may be desirable to place the markers at more frequent intervals. This is particularly true at points where a field is irregular, where they should be placed close enough to indicate clearly to a pilot desiring to land the exact outline of the usable area.

In addition to the boundary cones, fields may be marked with panel-type markers as shown in figure 27. Boundary markers of this type have been used in marking intermediate or emergency fields on the

Federal airways for a number of years, and markers of this general type have also been used on airports. These panel-type boundary markers are particularly useful in indicating the boundaries of an all-way turf area or of an irregular-shaped turf area without hard-surface runways. Care should be exercised in installing markers of

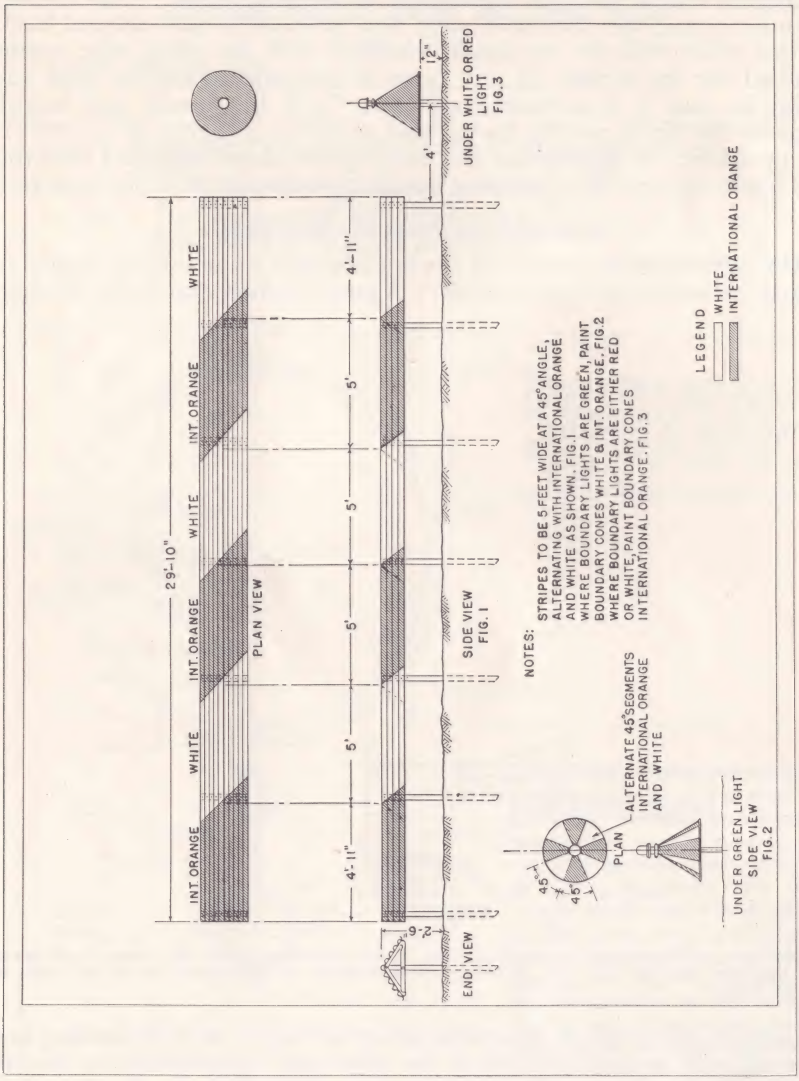


FIGURE 27.—Layout for painting intermediate field day marker. (Panel type.)

this character to place them so that there is little danger of planes striking them in either landing, taking off, or taxiing. A clearance of at least 8 to 10 inches from the ground should be used for all boundary markers, since this clearance will permit the cutting bar of average mowing equipment to pass under the markers.

Color combinations.—While the combination of chrome yellow and black has quite definitely been proven to be the most desirable for air

markers located on roofs, etc., for boundary markers and obstruction marking, etc., a combination of international orange and white should be used. A combination of international orange and black, however, has not proven effective and should not be used for either air-marking signs or other airport markings. Experience has shown that for airport markings and obstruction markings the combination of international orange and white is very effective against most backgrounds.

The use of international orange and white for marking obstructions in the northern section of the country, where considerable snowfall is experienced during the winter months, has been questioned. However, a check of this point with the pilots of the air lines operating through this section indicates that in their opinion this color combination is satisfactory even when the ground is covered with snow.

WIND-DIRECTION INDICATORS

Airplanes take off and land into the wind whenever practicable; hence it is important that provisions be made to indicate to pilots

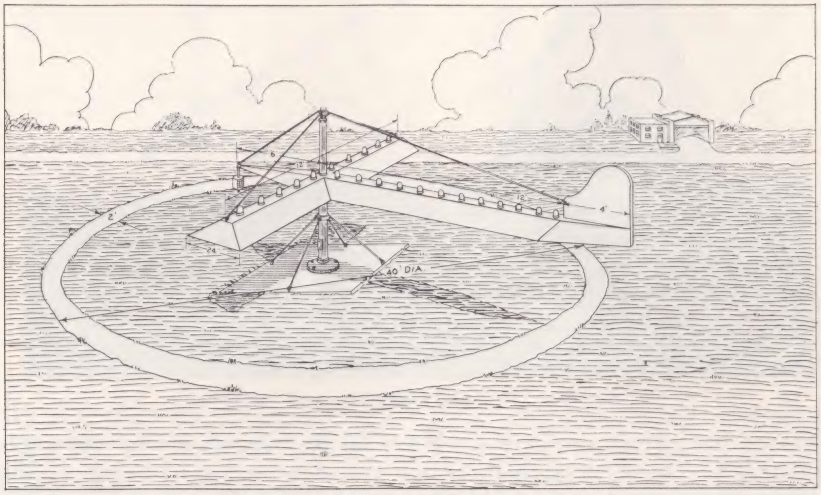


FIGURE 28.—Suggested design for illuminated wind T, using 25-watt incandescent lamps with green weatherproof hoods spaced on 12-inch centers. Note dimensions shown on sketch.

the true direction of the wind over the landing area. The conventional wind-direction indicators in use at present are either the wind cone or wind T. Both the cone and the T should be large enough and so located on the airport as to be visible to a pilot approaching the field from any direction from a height of 2,000 feet. The wind-direction indicator is among the first things a pilot looks for upon approaching an airport and it is important that it be conspicuously located and of such a color that it may be readily identified.

Figure 28 illustrates a typical wind T design. The T should be placed prominently on the airport but not within the usable portion of the landing area. Such an installation should be so constructed as to indicate at all times the true wind direction, provided that under

"no wind" conditions, the device will return to a position indicating the best landing direction on the airport involved.

The wind T itself should be painted international orange or international orange and white, surrounded by a white crushed rock or concrete circle on the ground having a diameter of 40 feet with a band 4 feet in width.

A wind indicator in the form of a large tetrahedron cell has been developed and used by the Army Air Corps. This indicator has some advantages over a conventional T. It is illustrated in figure 29.

In most cases where a wind T is installed at an airport one or more wind cones are located at points around the landing area so that at least one wind cone is visible from any angle of approach. The wind

FIGURE 29.—Illuminated tetrahedron wind indicator.

cone has the advantage over a wind T in that by observing the angle at which the cone streams out with the wind some estimate of the velocity of the wind may be obtained and also whether or not the wind is gusty.

A typical wind-cone installation is shown in figure 30. It is recommended that the cone be not less than 36 inches in diameter at the throat, 12 inches at the tail, and at least 12 feet in length. A cone should be mounted on a standard in such a way that the possibility of the cone fouling or wrapping around the support during sudden changes in wind direction is reduced to a minimum. Ball bearings or low friction bearings should be used for mounting the wind-cone assembly so that it is free to rotate with change in wind direction. Wind cones are usually located above the roof of some outstanding airport building or on a bracket on a beacon tower if the field is lighted.

OBSTRUCTION MARKING

The day marking of obstructions such as electrical supply and communication line poles and towers, radio towers, smokestacks, flag poles,

and other tall structures which are located in the immediate vicinity of the airport and which it is impracticable to remove, should be accomplished by painting these obstructions throughout their height with alternate bands of international orange and white, terminating with international orange bands at both the top and the bottom. The width of the international orange bands should be one-seventh the

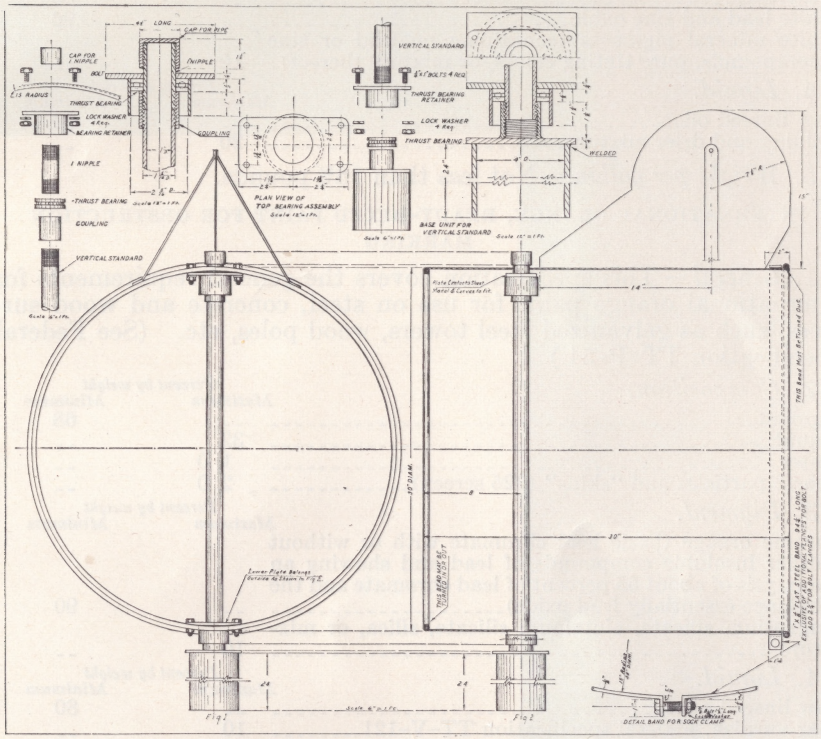


FIGURE 30.—Wind-direction indicator. Suggested mounting for conventional wind cone. Note that a metal cylinder is used for the first 30 inches in order to reduce likelihood of fabric cone fouling the standard. In this design the fabric cone is held in place by a bead on the rear of the metal cylinder and ring clamp which gives continuous support for the fabric cone instead of fastenings at four to six places as in some designs. The fabric cone is threaded on the ring clamp prior to fastening the ring in place. This method of holding the fabric cone in place results in longer life for the fabric. The vane on top of the metal cylinder assists in keeping the front of the indicator directly into the wind at all times and results in a more accurate indication of wind direction.

height of the structure for all structures less than 250 feet in height, and 30 to 40 feet wide for structures of over 250 feet in height. The white bands should be one-half the width of the international orange bands.

WHITE, READY-MIXED PAINT FOR AIR MARKERS AND OBSTRUCTION MARKING

1. *General.*—This specification covers the general requirements for white paint for use on steel, concrete, and wood surfaces, such as galvanized steel towers, service sheds, tankhouses, concrete directional arrows, galvanized iron roof surfaces, slate and tile roof surfaces, etc. (See Federal Specification TT–P–36a.)

2. *Composition.*

	Percent by weight Maximum	Minimum
Pigment	---	66
Liquid	34	--
Water	0. 5	--
Coarse particles and "skins" (325 screen)	2. 0	--

3. *Pigment.*

	Percent by weight Maximum	Minimum
White lead (basic carbonate, basic sulphate, or mixture thereof)	--	60
White lead and zinc oxide	--	90
White mineral pigments (containing no lead or zinc compounds, pure tinting colors, or mixture thereof)	10	--

4. *Liquid.*

	Percent by weight Maximum	Minimum
Raw linseed oil	--	80
Thinner and drier mixture	20	--

5. *Weight per gallon.*—Not less than 16¾ pounds.

INTERNATIONAL ORANGE, READY-MIXED PAINT FOR OBSTRUCTION MARKING

1. *General.*—This specification covers the general requirements for international orange paint for use on steel, concrete and wood surfaces, such as galvanized steel towers, wood poles, etc. (See Federal Specification TT–P–54.)

2. *Composition.*

	Percent by weight Maximum	Minimum
Pigment	--	68
Liquid	32	--
Water	1. 0	--
Coarse particles and "skins" (325 screen)	2. 0	--

3. *Pigment.*

	Percent by weight Maximum	Minimum
Chrome orange (basic lead chromate with or without other insoluble compounds of lead and showing an analysis of about 55 percent of lead chromate and the balance essentially lead oxide)	--	90
Magnesium silicate, aluminum silicate, silica, or mixture	10	--

4. *Liquid.*

	Percent by weight Maximum	Minimum
Raw linseed oil	--	80
Spar varnish, Federal specification TT–V–121	10	--
Thinner and drier	10	--

5. *Weight per gallon.*—Not less than 18 pounds.

In the case of structures such as large buildings, where sufficient surface is presented to permit painting with a checkerboard pattern, this method of marking is recommended. If the checkerboard marking is used, the colors should be a combination of international orange and white. The dimensions of the blocks used in marking water tanks should be in general not more than one-half the vertical face of the tank in height and one-eighth the circumference in width. In addition, the conical top of the tank should be divided into eight segmental elements, and painted alternate colors—with segmental elements above international orange blocks being painted white, and above white blocks being painted international orange. For other areas checkerboard blocks should as far as practicable be not less than 10 feet square.

Recommendations concerning the lighting of obstructions may be found in Civil Aeronautics Bulletin No. 10, Airport Lighting, published by the Civil Aeronautics Authority.

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